

What is claimed is:

1. An electrical power distribution system, comprising:

a solid state switch element having a control input and a load line for supplying current to a load, the solid state switch having a sense output for sourcing a sense current which is fractionally proportional to the load current;

a switching controller having a control output connected to the control input of the solid state switch element and a sense input connected to the sense output of the solid state switch element;

data processing means associated with the switching controller for storing and executing a direct current equivalent estimation routine, a load current threshold value, a heat index routine and an accumulated heat index threshold value; and

the data processing means using the sense current as an input for developing a direct current equivalent estimate of the load current, for further comparing the direct current equivalent estimate to the load current threshold value, for executing the heat index subroutine using the load current root mean square estimation as an input, responsive to the direct current equivalent estimate exceeding the load current threshold value for accumulating the results of execution of the heat index routine and further responsive to the direct current equivalent estimate falling below load current threshold value, for applying a decay factor to the accumulated results.

2. An electrical power distribution system as claimed in Claim 1, the data processing means further storing and executing a solid state switch duty cycle routine for generating a second input to the direct current equivalent estimation routine.

3. An electrical power distribution system as claimed in Claim 2, the data processing means further storing and executing an ignition cycle routine for controlling the number of fuse events allowed to occur for a solid state switch per ignition cycle.

4. A power controller comprising:

a power MOSFET having a drain for connection to a power supply, a source for connection to a load, a gate, and a load sense signal output;

data processing means connected to the gate for applying a gate control signal and coupled to the load sense signal output for receiving the load sense signal output; and

the data processing means providing for storing and executing programs including a duty control program for determining the normal conductive state of the MOSFET, a load current estimation program using the output of the duty control program and the load sense signal for inputs, an threshold program using the output of the load current estimation program as an input, and a heat index program using the results from the current estimation program and the threshold program as inputs for generating a gate control override signal for application to the gate for breaking conductivity through the MOSFET.

5. A power controller as claimed in Claim 4, the current estimation program further comprising means for generating a root mean estimation of load current from sampled values of the load sense signal and a duty cycle for the gate from the duty control program.

6. A power controller as claimed in Claim 5, the heat index program including a model of fuse behavior in which a heat index is incremented toward melting of a hypothetical fuse when the root mean estimation of load current exceeds a minimum threshold current and in which the heat index is subject to a decay function during periods then the root mean estimation is below the minimum threshold current.

7. A power controller as claimed in Claim 6, wherein the heat index program is a function of difference between the root mean estimation and the minimum threshold current.

8. A power controller as claimed in Claim 7, wherein the difference between the root mean estimation and the minimum threshold current is determined by the threshold program.

9. A power controller as claimed in Claim 8, and further comprising an analog to digital converter connected to receive the load sense signal output.

10. A power controller as claimed in Claim 9, wherein the data processing means includes a vehicle control network, a remote central electrical system controller and a MOSFET drive circuit located locally to the MOSFET.

11. A motor vehicle comprising:

a plurality of electrical circuits;

a switching element in each of the plurality of electrical circuits controlling energization thereof;

means for indicating the current drawn by each of the plurality of electrical circuits;

means for controlling the switch state of the switching elements in accord with a duty cycle for each of the switching elements; and

circuit protective means taking as inputs the indication of current drawn by a particular electrical circuit and the duty cycle for the switch controlling energization of the particular electrical circuit and for determining therefrom a estimation of time to melting of a hypothetical fuse as a signal for opening the switching element.

12. A motor vehicle as claimed in Claim 11, the switching element being a power MOSFET and the means for indicating current drawing including a output current sense signal generated by the MOSFET.

13. A motor vehicle as claimed in Claim 12, the means for controlling the switching state of switching elements further comprising a microprocessor programmed to execute a duty cycle routine.

14. A motor vehicle as claimed in Claim 13, the circuit protective means including a switching element control program for execution by the microprocessor, the program including a root mean estimation generation routine taking the output current sense signal and the output of the duty cycle routine as inputs, a threshold routine for determining whether the root mean estimation exceeds a current threshold, and a heat index routine taking the result of the threshold routine as an input and incrementing a heat index when the root mean estimation exceeds the current threshold and decrementing the heat index when the root mean estimation is less than the current threshold and for opening the switching element when the

accumulated heat index exceeds a heat threshold.

15. A motor vehicle as claimed in Claim 14, further comprising a motor vehicle network, where the microprocessor is part of an electrical system controller.